

# Observations on Past Decadal Surveys

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## Compelling and Feasible

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- APD Decadal Success Criteria: APD defines "full success" as delivery to the Decadal Survey Committee of compelling and executable concepts for all four large missions so that science can be adequately prioritized by the Committee.
  - By executable we mean *feasible* with respect to technical, cost, and risk resources outlined in the Study Report
- My interpretation: compelling and feasible\* will be determined by the Decadal Survey Committee prioritizing the concept.

\*The CATE team will assess cost and risk for the Decadal Survey.

# Decadal Survey Data Sources

- The National Academies has released 10 Decadal Surveys since 1964
  - First Decadal was ground-based only
  - Astrophysics has done the most Decadal Surveys (6)
  - Decadal Surveys are now done by all Divisions in SMD
  - All Survey reports can be downloaded for free from the National Academies
- In 2015 the Academies issued a report on Decadal Survey best practices
  - Report looked to minimize challenges experienced in the last round of surveys
  - Report chartered by SMD
  - <http://www.nap.edu/catalog/21788/the-space-science-decadal-surveys-lessons-learned-and-best-practices>

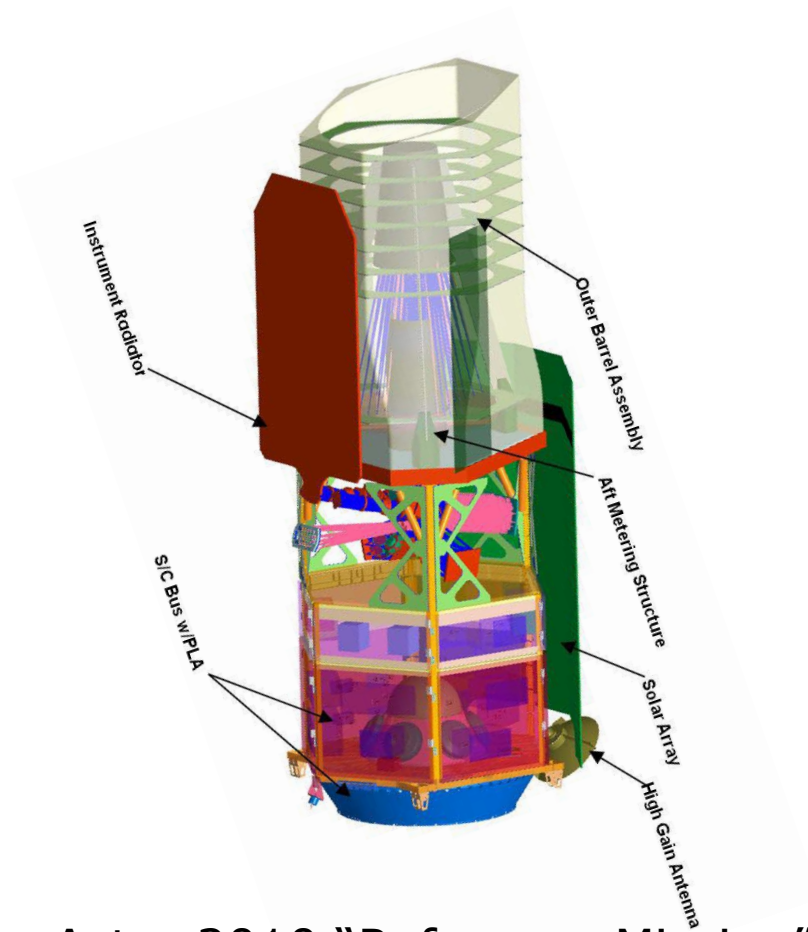


# 2015 Report – Selected Process Findings and Recommendations

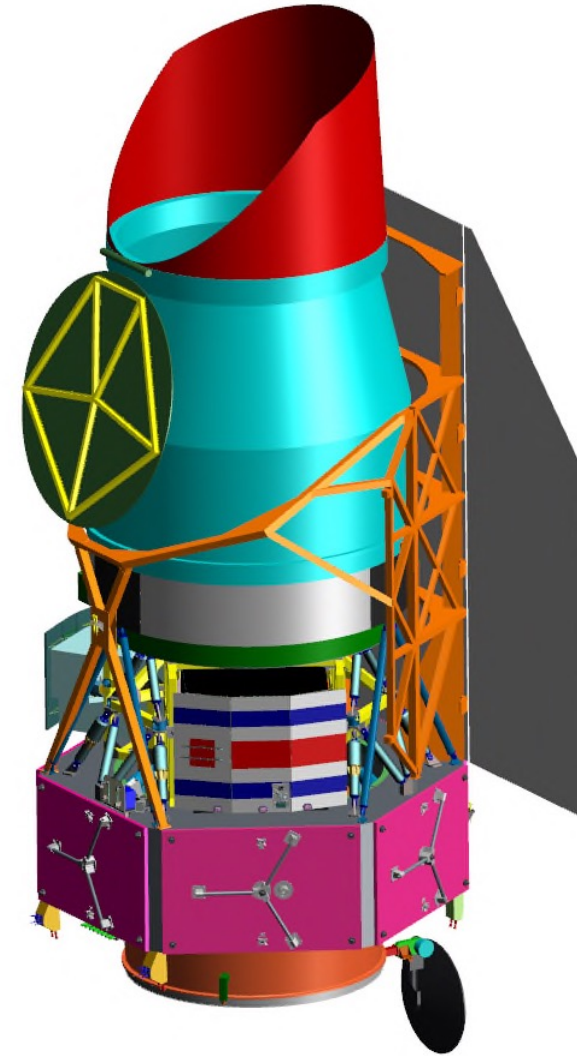
- 2015 report discussed how missions are prioritized
  - **Finding balance is key**
    - **Example: balance across the sub-disciplines, between mission and non-mission activities, between new and continued observations, across mission sizes, and between competed and directed missions.**
  - All surveys used science merit, cost and technology readiness as prioritization factors
  - All disciplines must make progress during the decade
- Recommends using “reference missions” to avoid over specifying the mission implementation
- Recommends including all past survey large concepts that have not started
- Surveys should avoid recommending “discipline-disrupting” missions
- Decision Rules and Cost Management
  - Recognizes that science creep on large missions is a major contributor to cost growth.
  - Recommends that the survey clearly state what science must remain to retain consensus priority
    - “It is imperative that survey committees make clear which parts of a performance-driven mission are truly required, and where any compromises or de-scopes might be acceptable.”
  - Recommends using decision rules to change or reevaluate survey priorities during the decade
  - Recommends including descope and cancellation triggers in the decision rules

For the full list of recommendations, see the [2015 Decadal Survey report](#).

# Reference Mission



Astro 2010 "Reference Mission"  
1.5m JDEM Omega

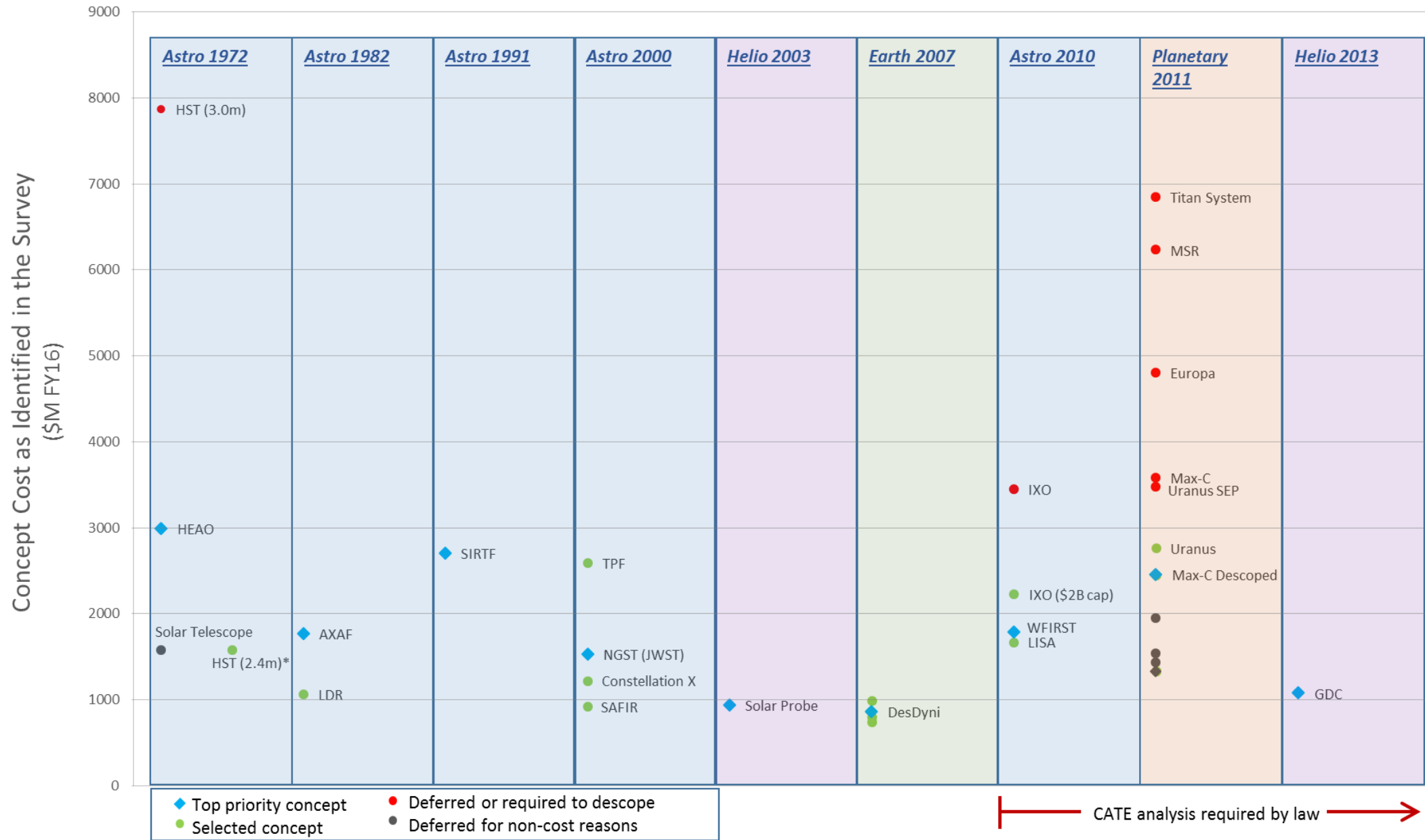


Current Mission Concept  
2.4m WFIRST

# Report Data Assessment Method

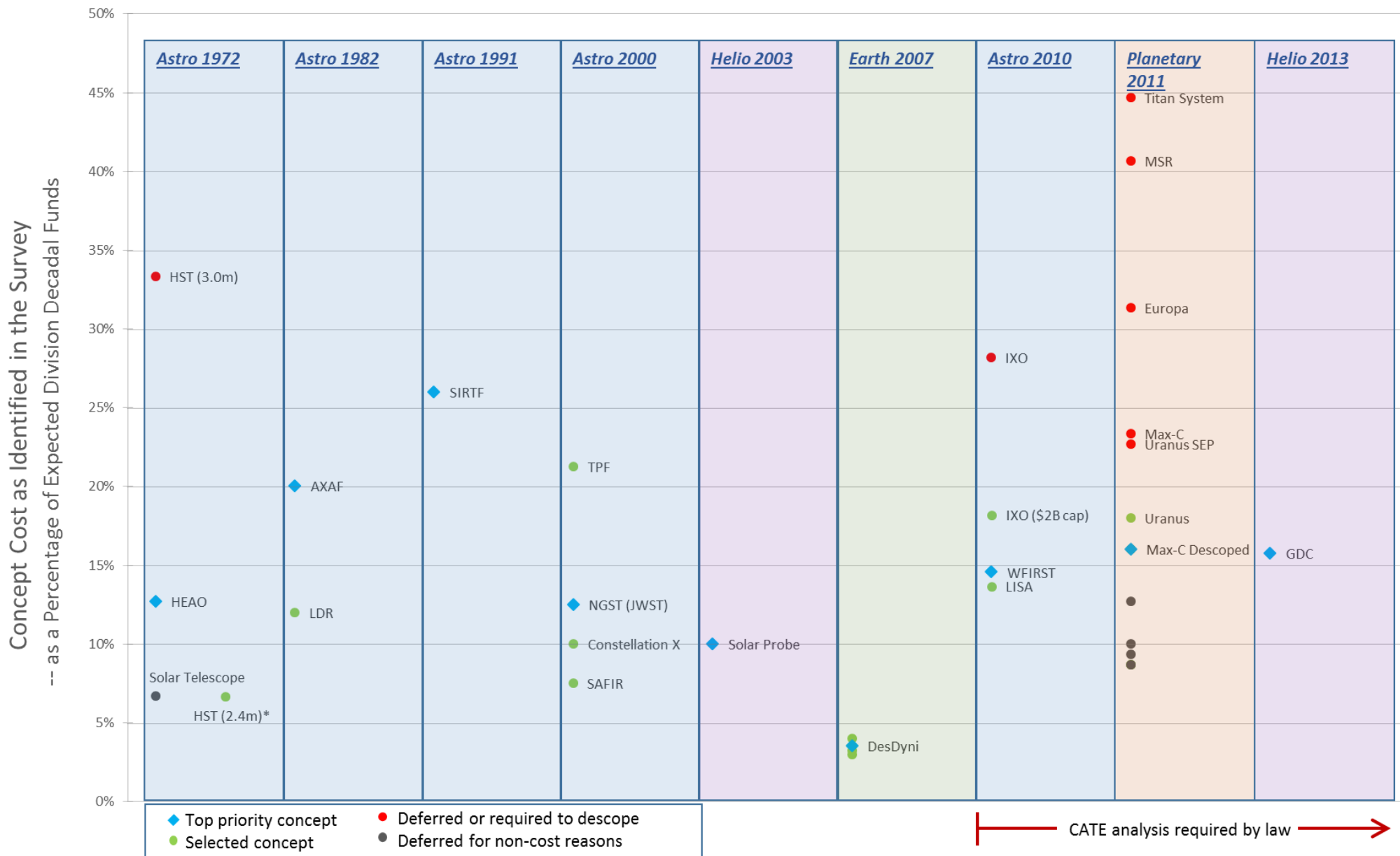
- My goal was to see if there are patterns in past Decadal Survey selections that might give us insight into Committee tolerances for mission concept cost and new technologies (risk)
  - Was not interested in actual mission cost or number of actual technologies developed, but rather what the Committee thought a mission would cost and how many technologies they thought it needed
- Collected all reported cost data on all large (<\$1B FY16) space missions in all past reports
  - Converted reported costs to \$ FY16 using the 2015 NASA New Start Inflation Index
  - Sorted into “prioritized” and “deferred” groupings
- Then took the reported cost data and divided by the expected Astrophysics Division funding level at the time of the report
  - Most Survey reports made reference to at least an annual funding level
  - One report did not have the funding data but the following report identified the funding level during the prior Survey
  - Another report also had no funding data. Data found in a presentation by the then APD Manager on-line. All other reports contained at least annual funding levels.
- Finally, read all reports back to Astro1991 for information on the number of new technologies required for each concept listed in Survey cost estimates.

# Decadal Survey Large Mission Reported Cost





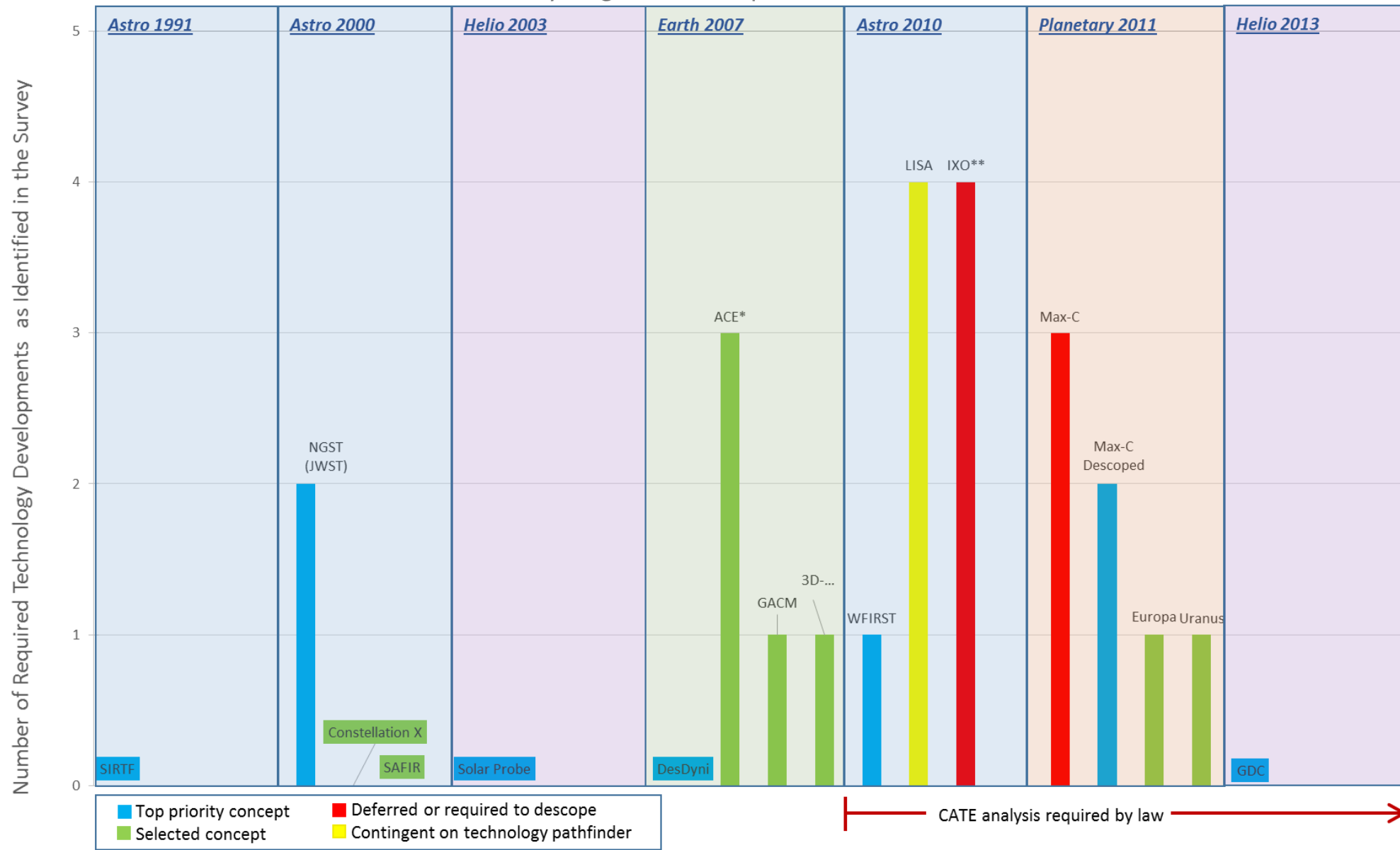
# Decadal Survey Large Mission Reported Cost



\*HST (2.4m) approved following a descope after the Decadal Survey



# Decadal Survey Large Mission Reported Technical Risks



\*ACE had 3 improvements on existing technology

\*\*IXO was given lowest priority contingent on cost descope and ESA selection.

IXO was recommended for technology funding only.

# Congressional Requirements on the Decadal Survey

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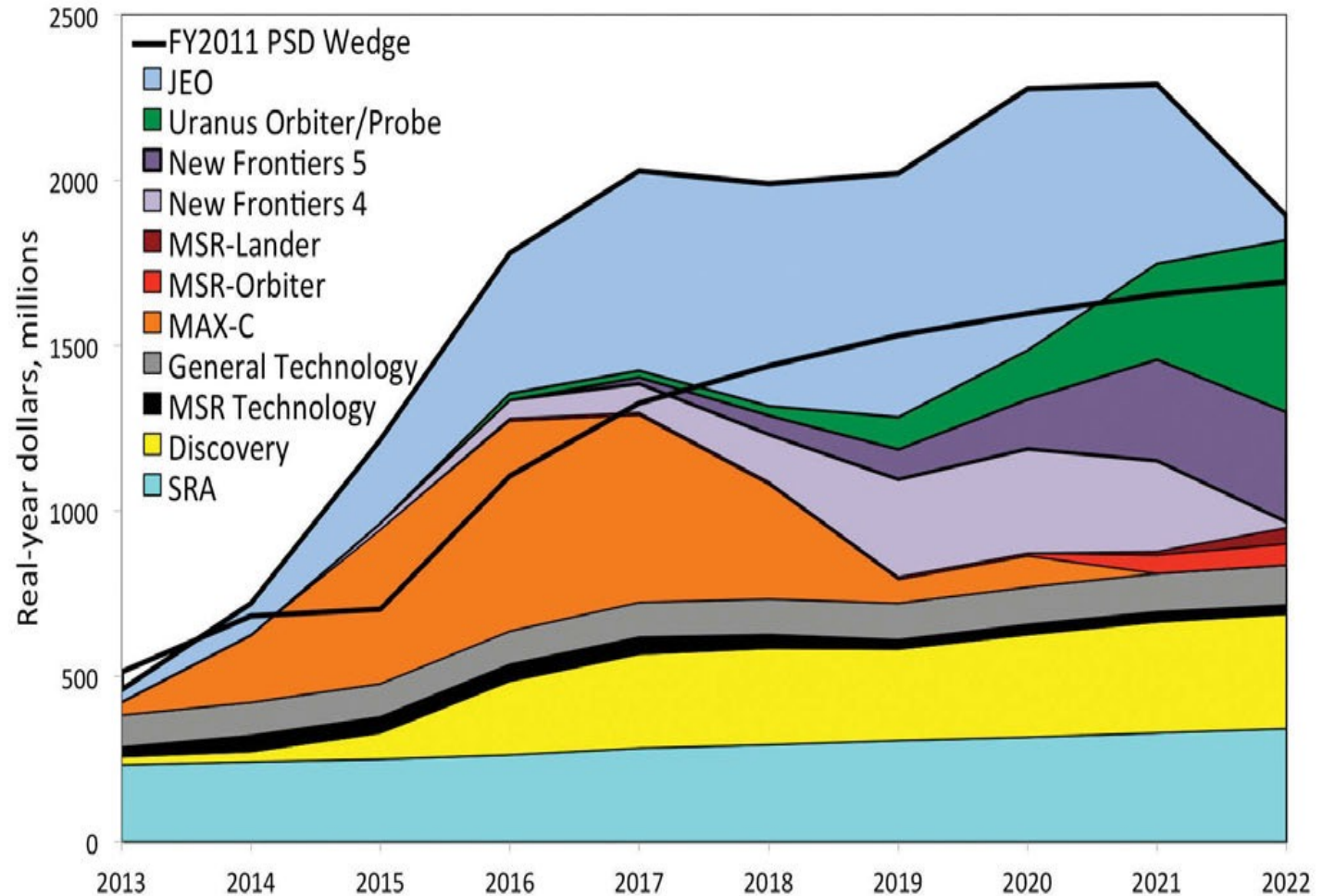
## From the NASA Appropriations Act of 2008:

### SEC. 1104. NATIONAL ACADEMIES DECADAL SURVEYS.

- (a) In General.—The Administrator shall enter into agreements on a periodic basis with the National Academies for independent assessments, also known as *decadal surveys*, to take stock of the status and opportunities for Earth and space science discipline fields and Aeronautics research and to recommend priorities for research and programmatic areas over the next decade.
- (b) Independent Cost Estimates.—The agreements described in subsection(a) shall include *independent estimates of the life cycle costs and technical readiness* of missions assessed in the decadal surveys whenever possible.
- (c) Reexamination.—The Administrator shall request that each National Academies decadal survey committee identify any conditions or events, such as significant cost growth or scientific or technological advances, that would warrant NASA asking the National Academies to reexamine the priorities that the decadal survey had established.

# 2015 Report – CATE Findings and Recommendations

- CATE develops cost and risk estimates for all major mission concepts in the survey
  - The estimates are spread over the decade and used to evaluate portfolio options by the survey committee
- CATE is considered a *best practice* and is viewed as highly successful
  - “...without a technical and cost risk metric relative science value between missions cannot be properly judged.”
- Recommended a two-step CATE process
  - Cost box criteria for initial round
  - Detailed estimate for final round



# Observations about the Decadal Survey Process

- The Decadal Survey has always prioritized only missions that appear to leave money for other astrophysics communities
  - “A successful federal research program must also be balanced. There is a tradeoff between investing in the development and construction of ambitious new telescopes and supporting broad-ranging observational and theoretical research that optimizes the return from operating facilities. The goal of the committee, consistent with its charge, has been to maximize the science return for a given budget.” – Astro2010
- All past missions prioritized by the Decadal Survey were thought to be under \$3B\*
  - \*\$FY16, cost to NASA.
- It’s a new mission start or technology money, but not both
  - Missions prioritized for a start (without required precursor missions or descopes) have always been seen as having 3 or less technologies to develop.
  - For a new mission start “we must use the tools we have”.
- The Decadal Survey has deferred extremely compelling mission concepts in the past
  - Examples: 3m Hubble (Astro 1972), Lunar Telescope (Astro 1991), 4m Theia and New Worlds concepts (Astro 2010), Mars Sample Return (Planetary 2011)
  - Compelling is not enough...technology readiness and cost must be part of the design process